

CONTEXT 5

MIXED CROP-LIVESTOCK, HUMID (MONOGASTRICS) SYSTEMS



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This brief provides an overview of the Investing in Sustainable Livestock (ISL) Guide and the full application of the accompanying ISL Tool to mixed crop-livestock, humid (monogastrics) systems (referred to below as Context 5).

CONTEXT 5: MIXED CROP-LIVESTOCK, HUMID (MONOGASTRICS) SYSTEMS

INTRODUCTION TO THE ISL GUIDE

The online ISL Guide (www.sustainablelivestockguide.org) is an information resource for designing and implementing environmentally sound livestock development projects. The guide has an interactive tool that provides context-specific guidance, suggested activities, and indicators to help livestock projects contribute to environmental sustainability; it also includes references for further investigation.

The ISL Guide is grounded in tested theory and evidence organized in seven principles for sustainability in the livestock sector. The World Bank and the Food and Agriculture Organization of the United Nations (FAO) specifically developed the following principles for the guide:

1. Contribute to a sustainable food future
2. Enhance carbon stocks
3. Increase productivity at animal and herd levels
4. Source feed sustainably
5. Couple livestock to land
6. Minimize fossil fuel use
7. Foster an enabling environment

Because the ISL Tool understands “sustainability” in a broad sense, it will eventually comprise elements not only of the environment but also of animal health and welfare, public health, and equity issues such as gender and inclusion. Thus, in due course, the World Bank and FAO will expand the scope of the tool to include guidance for addressing these issues in livestock projects.

STRUCTURE OF THE ISL TOOL

The ISL tool provides guidance for improving the environmental outcomes of livestock projects in the following 6 contexts, which cover the different livestock farming systems found worldwide

- Context 1: Grazing dry - Pastoral (ruminants)
- Context 2: Grazing temperate (ruminants)
- Context 3: Grazing sub-humid (ruminants)
- Context 4: Mixed crop-livestock, dry (ruminants)
- Context 5: Mixed crop-livestock, humid (monogastrics)
- Context 6: Intensive (ruminants and monogastrics)

The guidance provided for each of these contexts is organized according to objectives and interventions that are typically found in livestock investment projects. A broad review of projects funded by the World Bank Group and other Financial Institutions allowed to identify :

- Five broad objectives that livestock sector development commonly seeks to achieve: (i) improved productivity of livestock, (ii) improved market access and development of value chains, (iii) improved input and services delivery, (iv) climate change resilience and emergency response, and (v) strengthened policies, knowledge, and information.
- For each of these five objectives, a series of project interventions typically implemented (e.g. “improve animal health and welfare” for the objective “ improved productivity of livestock”), as well as more specific project activities that might be implemented under each intervention (e.g. “undertake vaccination campaigns”). For each objective, the identified interventions and activities differ according to the context of the project.

For every combination of context and intervention, the ISL Tool provides -specific guidance for improving the environmental outcomes, as well as suggested indicators for project monitoring and evaluation. The guidance integrates the trade-offs that may occur between environmental objectives where relevant and considers compromises among these trade-offs that can lead to submaximal environmental outcomes.

CONTEXT 5: MIXED CROP-LIVESTOCK, HUMID (MONOGASTRICS) SYSTEMS

OVERVIEW OF CONTEXT 5: MIXED CROP-LIVESTOCK, HUMID (MONOGASTRICS) SYSTEMS

Context 5 covers mixed crop-livestock systems characterized by high integration of livestock, crops, and often aquaculture. These systems are found in areas where high rainfall supports both crops and livestock and typically produce for both the household and market.

Description of typical situation

In large parts of Asia, mixed crop-livestock systems integrate rice production, livestock (poultry, ducks, geese, and pigs), aquaculture, fruits and vegetables, and cash crops. These systems are, for example, found in Bangladesh, China, India, Indonesia, Malaysia, Thailand, Myanmar, and Vietnam. Such farming systems are known as integrated farming systems, referring to the high level of integration among farm activities.

Despite a global trend toward specialization of farming systems, these integrated, smallholder mixed-crop livestock systems continue to be found in regions with high water availability, i.e., river deltas and regions with high precipitation. Farms are small (0.5–3 ha), labor is predominantly provided by household members, land for farm extension is limited, and farm activities are generally market-oriented, though production of rice for household consumption is an important objective. Integration of the different components of the system is achieved through the recycling of nutrients and organic matter: Livestock manure is either applied or deposited directly to (on) the crops or used to fertilize fish ponds, with the sediment of the ponds used as a fertilizer. Crop residues and household wastes may be used for livestock feeding. For example, in the Mekong Delta of Vietnam, these integrated farming systems developed from subsistence-oriented rice monoculture, where the livestock component grew rapidly in response to the market demand for livestock products, fruit and vegetables, and cash crops. The farm activities in such integrated systems are quite labor-intensive and are intensifying in response to increasing market demands and the need to support livelihoods.

Common environmental issues

Integrated farming systems are at risk of accumulating nitrogen and phosphorus through the import of synthetic fertilizers and concentrate feeds as well as inadequate management of nutrients. For example, authors reported the use of soybean meal and wheat flour from Argentina, maize gluten meal from Brazil, palm kernel expeller from the Philippines, and rapeseed meal from India as feed ingredients for poultry and pigs in Vietnam. The use of synthetic fertilizer was also reported to contribute to nitrogen pollution. Such nutrient concentrations cause pollution of soil, water, and air, with repercussions on biodiversity, climate, and human health (Principles 4 and 5).

Globally, across all systems, pigs and poultry contribute about 9% and 8%, respectively, to global (GHG) emissions associated with livestock. This contribution is mainly through emissions associated with feed (60%) and manure storage and processing (27%). It is also reported that the pig production component of integrated systems had a higher GHG emission than specialized pig production systems (context 5). (Principles 3, 4, 5 and 6)

The intensification of the livestock component of integrated farming systems will result in increased feeding of concentrates, which will likely consist of grown maize, soy, wheat, and barley. The resulting pressure on land and water, land use change, and biodiversity losses tendentially caused by feed production are important issues associated with production in this context (Principle 4).

CONTEXT 5: MIXED CROP-LIVESTOCK, HUMID (MONOGASTRICS) SYSTEMS

ISL TOOL GUIDANCE TABLE: CONTEXT 5: MIXED CROP-LIVESTOCK, HUMID (MONOGASTRICS) SYSTEMS

The section below includes guidance for improving the environmental outcomes of five broad objectives that livestock development projects commonly seek to achieve. Typical interventions and specific activities are suggested under each objective, as well as guidance and indicators for improving environmental outcomes and monitoring and evaluating progress toward these outcomes. The guidance also references relevant Principles of Investment in Sustainable Livestock (Principles 1 – 7 or “P1” through “P7”) for further reading.

OBJECTIVE 1: IMPROVE THE PRODUCTIVITY OF LIVESTOCK

INTERVENTION: EXPAND FEED RESOURCES AND BALANCE FEED RATIONS

ACTIVITIES

- Develop on-farm feed resources.
- Source (ingredients for) concentrate feed.
- Improve feed ration balancing.

GUIDANCE

- P3 Adequate feed ration balancing, for instance, through the application of ration formulation models, improves feed conversion ratio, thus reducing costs per unit produced, improving natural resource use efficiency, and decreasing greenhouse gas (GHG) emissions per unit of product. [Feedipedia](#), [NCAT 2013](#).
- P4, P5, P7 Raise awareness among stakeholders and provide producers with technical assistance, financing options, and knowledge-sharing mechanisms on sustainable feed production, i.e., production of soybeans and feed maize as a cash crop. Improve crop production practices (for such feed crops but also for rice, fruits, vegetables, and cash crops) with maximal use of manure and/or fish pond sediment.
- P4, P5 Assess local availability of concentrate feed ingredients, i.e., agro-industrial by-products of high nutritional value. Adopt feed P7 budgeting approaches and feed conservation to ensure a stable feed supply throughout each season. Consider the effect of feed interventions on GHG emissions and on water and land resources. Assess the resilience of the system to deal with short- and long-term perturbations, such as droughts, floods, warfare, and climate change. [FAO 2012b](#), [FAO 2014a](#).
- P4, P7 Source sustainably any feed imported, considering the fossil fuel emissions generated for feed production and transport, as well as the use of heavy metals and other environmental impacts on land and water resources. Include the environmental impacts associated with imported feed in project environmental impact assessments. [LEAP 2016b](#). Promote the piloting of a livestock feed certification and labeling schemes.
- P3 Improved feed availability and quality may not only increase animal productivity but also enable overall production increase. Evaluate the potential implications of any foreseen increase in livestock numbers on GHG emissions, pollution, and land and water use. [LEAP 2018a](#), [LEAP 2018b](#), [LEAP 2016c](#).

INDICATORS

Reduced net GHG emissions (CO₂-eq) per unit (kg) of product for selected agricultural commodities (e.g., milk, meat, and eggs) — Percentage. This indicator measures the climate impact — i.e., net greenhouse gas (GHG) emissions, including soil carbon sequestration — of agricultural commodity production. It measures the change in the net emission of GHG per unit of agricultural product, including sources and sinks along the supply chain. GHG emissions are converted to carbon dioxide (CO₂) equivalent using standard global warming potential values. Quantification can be performed using IPCC [2006 Guidelines](#), calculators (e.g., [GLEAM-i](#), [Cool Farm Tool](#)). The team may consider using certified methodologies, such as the [Gold Standard Small Holder Dairy Methodology](#) to generate tradeable GHG mitigation outcomes as well as the [LEAP 2018 guidelines for assessing environmental performance in pig supply chains and in large ruminant supply chains](#).

- Quantification may be undertaken at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys to parameterize models, together with activity data from the monitoring system.

OBJECTIVE 1: IMPROVE THE PRODUCTIVITY OF LIVESTOCK

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number.

This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

Irrigation water used in feed production — Cubic meter per unit of feed. This indicator measures the amount of irrigation water used for feed production (e.g., expressed in cubic meter per unit of dry matter or cubic meter per unit of digestible energy).

- Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2016 Environmental performance of animal feeds supply chains](#).

Pesticides used in feed production — Amount per unit of feed. This indicator measures the amount of pesticides used for feed production (e.g., expressed per unit of dry matter or per unit of digestible energy).

- Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2016 Environmental performance of animal feeds supply chains](#).

Competition with food production — Share. This indicator reports the change in the portion of feed consumed by livestock in the project that is not directly human-edible or is produced on land not suited for crop production.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

INTERVENTION: IMPROVE ANIMAL HEALTH AND WELFARE

ACTIVITIES

- Undertake vaccination campaigns.
- Improve disease prevention and control.
- Avoid antimicrobial resistance (AMR).
- Improve animal welfare.

GUIDANCE

- P3 Animal health and welfare improvements contribute to sustainability on an animal level by lowering morbidity and mortality, reducing stress on the animal, and consequently improving productivity at the animal and herd levels, since improved health and welfare improve reproductive performance; consequently, smaller populations of reproductive animals can be maintained. Reduced mortality also diminishes incentives to increase livestock population size to compensate for animal losses. Increased productivity and reduced livestock populations subsequently contribute to minimizing pressure on natural resources and emissions per unit of product. [FAWC 2009](#), [FAO 2013b](#), [FAO 2017b](#), [RAF 2007](#).

OBJECTIVE 1: IMPROVE THE PRODUCTIVITY OF LIVESTOCK

- P7 Raise awareness among stakeholders about the environmental benefits of improving animal health and welfare.
- P3 Animal health and welfare improvements may incentivize the growth of the population of pigs, poultry, and ducks, and thus the overall demand for feed and manure produced. Evaluate the potential implications of any foreseen increase in livestock numbers on manure management, GHG emissions, and pressure on land and water resources. LEAP 2018a, LEAP 2018b, LEAP 2016c

INDICATORS

Reduced net GHG emissions (CO₂-eq) per unit (kg) of product for selected agricultural commodities (e.g., milk, meat, and eggs) — Percentage. This indicator measures the climate impact — i.e., net greenhouse gas (GHG) emissions, including soil carbon sequestration — of agricultural commodity production. It measures the change in the net emission of GHG per unit of agricultural product, including sources and sinks along the supply chain. GHG emissions are converted to carbon dioxide (CO₂) equivalent using standard global warming potential values. Quantification can be performed using IPCC [2006 Guidelines](#), calculators (e.g., [GLEAM-i](#), [Cool Farm Tool](#)). The team may consider using certified methodologies, such as the [Gold Standard Small Holder Dairy Methodology](#) to generate tradeable GHG mitigation outcomes as well as the [LEAP 2018 guidelines for assessing environmental performance in pig supply chains and in large ruminant supply chains](#).

- Quantification may be undertaken at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys to parameterize models, together with activity data from the monitoring system.

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number. This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

INTERVENTION: IMPROVE ANIMAL GENETICS

ACTIVITIES

- Improve livestock genetics either through cross-breeding with exotic breeds or through selection for improved genetics within the existing livestock population.

GUIDANCE

- P3 Improving livestock genetics boosts productivity and concomitantly contributes to sustainability by reducing GHG emissions and pressure on natural resources per unit of product. [FAO 2010](#), [ILRI 2017b](#).
- P3 Consider the effect of introducing high-productivity breeds (which require high-quality feed and may not be resilient to diseases) on the broader system resilience to short and long-term perturbations such as droughts, floods, warfare, and climate change.
- P4 Cross-breeding with high-productivity breeds may require more and higher-quality feeds, potentially increasing the environmental impacts of feed production. Ensure that any increased demand for higher-quality feed is met sustainably.

OBJECTIVE 1: IMPROVE THE PRODUCTIVITY OF LIVESTOCK

INDICATORS

Reduced net GHG emissions (CO₂-eq) per unit (kg) of product for selected agricultural commodities (e.g., milk, meat, and eggs) — Percentage. This indicator measures the climate impact — i.e., net greenhouse gas (GHG) emissions, including soil carbon sequestration — of agricultural commodity production. It measures the change in the net emission of GHG per unit of agricultural product, including sources and sinks along the supply chain. GHG emissions are converted to carbon dioxide (CO₂) equivalent using standard global warming potential values. Quantification can be performed using IPCC [2006 Guidelines](#), calculators (e.g., [GLEAM-i](#), [Cool Farm Tool](#)). The team may consider using certified methodologies, such as the [Gold Standard Small Holder Dairy Methodology](#) to generate tradeable GHG mitigation outcomes as well as the [LEAP 2018 guidelines for assessing environmental performance in pig supply chains and in large ruminant supply chains](#).

- Quantification may be undertaken at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys to parameterize models, together with activity data from the monitoring system.

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OBJECTIVE 2: IMPROVE MARKET ACCESS AND DEVELOP VALUE CHAINS

INTERVENTION: DEVELOP PRODUCER ORGANIZATIONS AND PRODUCTIVE ALLIANCES

ACTIVITIES

- Establish and/or build the capacity of new/existing producer organizations.
- Provide financing for subprojects under productive alliances.

GUIDANCE

- P7 Raise awareness among smallholders and increase capacity through the development of cooperatives or other types of organizations and education/knowledge sharing about sustainability issues related to livestock production.
- P7 Provide smallholders or organizations with technical assistance on developing environmental monitoring, plans, and programs and on gaining access to related funds (e.g., for ecosystem management or renewable energy development).
- P7 Include environmental criteria in subproject selection (e.g., presence of a waste management plan or a sustainable water use plan). Establish a line of credit for activities with additional environmental benefits (e.g., renewable energy generation, maintenance of live fences and trees in open pasture).

INDICATORS

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number.

This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

INTERVENTION: CONSTRUCT/UPGRADE POST-FARM-GATE FACILITIES

ACTIVITIES

- Improve transport and storage capacity.
- Improve/build processing plants, slaughterhouses, dairy processing, and wet markets.

GUIDANCE

- P6 Improve access to energy-efficient technology for storage, processing, transportation, and refrigeration equipment to minimize loss and waste as well as improve food safety. [IEE 2007](#), [LEAP 2016c](#), [LEAP 2016d](#).

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OBJECTIVE 2: IMPROVE MARKET ACCESS AND DEVELOP VALUE CHAINS

- P6 Integrate energy-efficient machinery and equipment into technical design and financial analysis. IEE 2007.
- P6 Support investment in renewable energy production: technical assistance, subsidies (e.g., matching grants, soft loans) and energy pricing.
- P5 Develop comprehensive waste management plans: waste stream minimization, waste collection, storage, processing, and discharge/recycling. [SNV Biogas](#), [GMI 2013](#), [Teenstra et al. 2014](#), [CCAC 2015](#), [FAO 2013a](#).

INDICATORS

Processing plants and markets that have adopted a waste management plan — Number or percentage. This indicator measures the number of slaughterhouses, dairies and other processing units, animal gathering points, and markets that have received project support to develop and implement liquid and solid waste management plans. At a minimum, plans should address the reduction of waste streams, waste collection, storage, and treatment.

→ Quantification may be reported annually using project advancement reports.

Energy-saving and renewable energy production devices and plans supported by the project — Number. This indicator measures the number of energy-saving and renewable energy production devices installed by the project, either directly or indirectly (through policies and energy pricing). Energy-saving investments may include systems for energy recovery in milk cooling; upgraded thermic insulation; efficient burners; and energy use efficiency plans at the company level. Renewable energy production includes solar panels, biodigesters, solar panels, wind power, and micro-hydropower.

→ Quantification may be undertaken annually or at project start, mid-term, and terminal evaluation, using dedicated surveys.

Reduction of pollution discharge into waterways — Percentage. This indicator measures the reduction in nitrate, phosphates, and BOD and E. Coli discharge (a) at the end of the pipe of the individual farms or community and (b) at critical downstream locations to be defined in the monitoring and evaluation (M&E) plan.

→ Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2018 Nutrient Flows and associated environmental impacts in livestock supply chains. Guidelines for assessment.](#)

INTERVENTION: CREATE OPPORTUNITIES ALONG THE VALUE CHAIN

ACTIVITIES

- Develop a market demand for products produced under the project.
- Establish and promote a segmented livestock market.

GUIDANCE

- P7 Local mixed-crop livestock production systems can be a strong market entry point for sustainably produced products. Establish and promote labeling and/or certification schemes for niche products that are environmentally sustainable.

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OBJECTIVE 2: IMPROVE MARKET ACCESS AND DEVELOP VALUE CHAINS

- P7 Raise awareness among consumers about the sustainability of livestock products produced under the project and about their relative nutritional values.

INDICATORS

Amount of animal source food in diet — Grams per capita per day — variation in percentage. This indicator measures the increase or decrease in animal source food in human diets, within a beneficiary population (kilogram intake per capita per year). It distinguishes populations having low or high baseline consumption, for instance, by using national dietary recommendations as a reference.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

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OBJECTIVE 3: IMPROVE INPUT AND SERVICES DELIVERY

INTERVENTION: DEVELOP PUBLIC AND PRIVATE EXTENSION SERVICES

ACTIVITIES

- Provide extension agents with training and capacity building.
- Develop extension manuals and curricula.

GUIDANCE

- P7 Include environmental issues in training courses and manuals. Embed environmental management in animal production practices.
- P7 Train extension agents to collect data on environmental performance of farms.
- P7 Build awareness and environmental management capacity of producers and producer associations through knowledge-sharing mechanisms.

INDICATORS

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number.

This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

INTERVENTION: IMPROVE PUBLIC AND PRIVATE ANIMAL HEALTH SERVICES

ACTIVITIES

- Provide veterinarians and animal health workers with training and capacity building.
- Develop veterinary and animal health manuals and curricula.

GUIDANCE

- P7 During training, raise awareness among veterinarians and animal health workers on environmental issues and their links to animal health and welfare.
- P7 Introduce links to natural resource management issues and options in animal health manuals and curricula.

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OBJECTIVE 3: IMPROVE INPUT AND SERVICES DELIVERY

INDICATORS

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number.

This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

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INTERVENTION: STRENGTHEN PROVISION OF INPUT AND SERVICES

ACTIVITIES

- Provide private service and input providers with training and seed financing.
- Foster the development of new services where gaps exist.
- Provide financing options for new and innovative models for service delivery.

GUIDANCE

P7 Assess demand and provide seed financing for services that contribute to sustainability: green economy (e.g., solar panels and biogas installation construction and maintenance). [IEE 2007](#), [SNV Biogas](#).

P4, P5, Develop markets for sustainable inputs, such as sustainably sourced feed, organic fertilizers, and organic pesticides.
P7

INDICATORS

Energy-saving and renewable energy production devices and plans supported by the project — Number. This indicator measures the number of energy-saving and renewable energy production devices installed by the project, either directly or indirectly (through policies and energy pricing). Energy-saving investments may include systems for energy recovery in milk cooling; upgraded thermic insulation; efficient burners; and energy use efficiency plans at the company level. Renewable energy production includes solar panels, biodigesters, solar panels, wind power, and micro-hydropower.

- Quantification may be undertaken annually or at project start, mid-term, and terminal evaluation, using dedicated surveys.

Proportion of surplus nutrients sold for use as organic fertilizer. For those farms with nutrient surpluses that are greater than 10-20%, this indicator measures the proportion of the surplus nutrients that is sold for use as organic fertilizer. This indicator is quantified by calculating the total surplus, the amount of that surplus that is applied to crop production on the farm, and the proportion of the remaining surplus that is sold for use as organic fertilizer.

- Quantification may be reported annually based on the production unit management data or surveys. [LEAP 2018 Nutrient Flows and associated environmental impacts in livestock supply chains. Guidelines for assessment.](#)

OBJECTIVE 3: IMPROVE INPUT AND SERVICES DELIVERY

Farmers/extension agents/service providers trained on environmental issues and options in the livestock sector — Number.

This indicator measures the number of stakeholders along the supply chains that have been made aware of and trained on environmental issues in the livestock sector, for instance, through the inclusion of environmental issues and options in curriculums, extension manuals, capacity development programs, etc.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

Irrigation water used in feed production — Cubic meter per unit of feed. This indicator measures the amount of irrigation water used for feed production (e.g., expressed in cubic meter per unit of dry matter or cubic meter per unit of digestible energy).

- Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2016 Environmental performance of animal feeds supply chains](#).

Pesticides used in feed production — Amount per unit of feed. This indicator measures the amount of pesticides used for feed production (e.g., expressed per unit of dry matter or per unit of digestible energy).

- Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2016 Environmental performance of animal feeds supply chains](#).

Competition with food production — Share. This indicator reports the change in the portion of feed consumed by livestock in the project that is not directly human-edible or is produced on land not suited for crop production.

- Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

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OBJECTIVE 4: CLIMATE CHANGE RESILIENCE AND EMERGENCY RESPONSE

INTERVENTION: IMPROVE MANURE, NUTRIENTS, AND WASTE MANAGEMENT

ACTIVITIES

- Improve integrated manure management on farms, including fish ponds.
- Develop territorial approaches to improving the nutrient balance.

GUIDANCE

P5, P6, P7 Raise awareness among stakeholders about integrated manure management and its co-benefits for the fertility and resilience of agricultural soils. Provide technical assistance and financing options to ensure that manure is adequately managed: collected, safely stored (concrete floor and roof), and processed (e.g., composted, used in anaerobic digestion, dried, and processed into organic fertilizer), or applied to fish ponds, cropland, and pastureland. If the latter, ensure that the timing and dosing are in line with requirements. [Teenstra et al. 2014](#), [LEAP 2018a](#), [CCAC 2015](#), [FAO 2013a](#), [SARE 2018](#).

P5, P7 Support the development of land/livestock balance regulation and national nutrient management plans to utilize the nutrient value of manure and/or fish pond sediment in crop production, contributing to soil health, agricultural resilience, and national food security. Develop or revise policies to incentivize the substitution of synthetic fertilizers with manure and/or fish pond sediment (e.g., reduced subsidies on synthetic fertilizers; subsidies for manure storage and processing as well as fish pond development) and to avoid excess fertilization.

P6, P7 Provide livestock farms with technical assistance and financing options for the piloting of biogas schemes to generate renewable energy. [SNV Biogas](#), [GMI 2013](#).

INDICATORS

Reduced net GHG emissions (CO₂-eq) per unit (kg) of product for selected agricultural commodities (e.g., milk, meat, and eggs) — Percentage. This indicator measures the climate impact — i.e., net greenhouse gas (GHG) emissions, including soil carbon sequestration — of agricultural commodity production. It measures the change in the net emission of GHG per unit of agricultural product, including sources and sinks along the supply chain. GHG emissions are converted to carbon dioxide (CO₂) equivalent using standard global warming potential values. Quantification can be performed using IPCC [2006 Guidelines](#), calculators (e.g., [GLEAM-i](#), [Cool Farm Tool](#)). The team may consider using certified methodologies, such as the [Gold Standard Small Holder Dairy Methodology](#) to generate tradeable GHG mitigation outcomes as well as the [LEAP 2018 guidelines for assessing environmental performance in pig supply chains and in large ruminant supply chains](#).

- ➔ Quantification may be undertaken at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys to parameterize models, together with activity data from the monitoring system.

Processing plants and markets that have adopted a waste management plan — Number or percentage. This indicator measures the number of slaughterhouses, dairies and other processing units, animal gathering points, and markets that have received project support to develop and implement liquid and solid waste management plans. At a minimum, plans should address the reduction of waste streams, waste collection, storage, and treatment.

- ➔ Quantification may be reported annually using project advancement reports.

OBJECTIVE 4:

CLIMATE CHANGE RESILIENCE AND EMERGENCY RESPONSE

Energy-saving and renewable energy production devices and plans supported by the project — Number. This indicator measures the number of energy-saving and renewable energy production devices installed by the project, either directly or indirectly (through policies and energy pricing). Energy-saving investments may include systems for energy recovery in milk cooling; upgraded thermic insulation; efficient burners; and energy use efficiency plans at the company level. Renewable energy production includes solar panels, biodigesters, solar panels, wind power, and micro-hydropower.

→ Quantification may be undertaken annually or at project start, mid-term, and terminal evaluation, using dedicated surveys.

Livestock production units that have adopted a manure management plan — Number. This indicator measures the number of production units that have received project support to develop and implement manure management plans. Improved manure management practices and plans should be defined in the project document and address, at a minimum, manure collection, storage, and the recycling schedule. Manure processing and recording of manure transfer may also be included, if relevant.

→ Quantification may be undertaken annually, using project advancement reports.

Proportion of production units for which nutrient flows are balanced — Percentage. This indicator measures simple nitrogen and phosphorus balances at the production unit level, as the difference between inputs (e.g., fertilizer, feed) and outputs (e.g., animal and crop products, manure exports). Nutrient flows are considered when the difference between inputs and outputs does not exceed 10-20%.

→ Quantification may be reported annually based on the production unit management data or surveys. [LEAP 2018 Nutrient Flows and associated environmental impacts in livestock supply chains](#). Guidelines for assessment.

Proportion of surplus nutrients sold for use as organic fertilizer. For those farms with nutrient surpluses that are greater than 10-20%, this indicator measures the proportion of the surplus nutrients that is sold for use as organic fertilizer. This indicator is quantified by calculating the total surplus, the amount of that surplus that is applied to crop production on the farm, and the proportion of the remaining surplus that is sold for use as organic fertilizer.

→ Quantification may be reported annually based on the production unit management data or surveys. [LEAP 2018 Nutrient Flows and associated environmental impacts in livestock supply chains](#). Guidelines for assessment.

Reduction of manure and waste discharge — Percentage. This indicator measures the reduction percentage of production units that discharge waste, manure, and slurry into waterways or unmanaged/unlined lagoons.

→ Quantification may be undertaken annually or at the start of the project, at medium term, and during terminal evaluation, using dedicated surveys.

Reduction of pollution discharge into waterways — Percentage. This indicator measures the reduction in nitrate, phosphates, and BOD and E. Coli discharge (a) at the end of the pipe of the individual farms or community and (b) at critical downstream locations to be defined in the monitoring and evaluation (M&E) plan.

→ Quantification may be reported annually based on sampling and direct measurements following a predefined protocol. [LEAP 2018 Nutrient Flows and associated environmental impacts in livestock supply chains](#). Guidelines for assessment

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OBJECTIVE 4:

CLIMATE CHANGE RESILIENCE AND EMERGENCY RESPONSE

INTERVENTION: DEVELOP RISK MANAGEMENT PROGRAMS AND PRODUCTS

ACTIVITIES

- Develop livestock insurance and credit schemes.
- Establish an emergency contingency fund.

GUIDANCE

P7 Include appropriate measures to deal with dead and culled animals during disease control interventions. Particular attention should be paid to incineration and burying protocols. [LEGS, FAO 2016](#).

INDICATORS

Contingency fund for livestock emergencies created and operational — Yes/no. This indicator measures the creation and funding of a contingency fund for livestock emergencies related to drought, disease, and other hazards.

→ Quantification may be reported annually using project advancement reports.

INTERVENTION: ENSURE RESILIENCE OF BUILDINGS AND EQUIPMENT TO EXTREME WEATHER EVENTS

ACTIVITIES

- Develop industrywide crisis response plans.
- Develop seasonal assessments to forecast potential crises.

GUIDANCE

P7 Harmonize early warning information systems with information systems on livestock, climate, and weather.

P7 Embed basic environmental management practices in training and capacity-building programs on crisis response. [LEGS, FAO 2016](#).

P7 Include an assessment of buildings' exposure and vulnerability to extreme weather events in the approval process for new production units.

INDICATORS

Contingency fund for livestock emergencies created and operational — Yes/no. This indicator measures the creation and funding of a contingency fund for livestock emergencies related to drought, disease, and other hazards.

→ Quantification may be reported annually using project advancement reports.

OBJECTIVE 1

OBJECTIVE 2

OBJECTIVE 3

OBJECTIVE 4

OBJECTIVE 5

OBJECTIVE 5: CLIMATE CHANGE RESILIENCE AND EMERGENCY RESPONSE

INTERVENTION: DEVELOP AND HARMONIZE LIVESTOCK POLICIES, PLANS, REGULATIONS, AND PROGRAMS

ACTIVITIES

- Introduce new policies and regulations or update current ones.
- Develop a national livestock master plan.

GUIDANCE

- P7 Develop programs to achieve environmental benefits in livestock production (e.g., payments for environmental services [IIED 2013](#), carbon offsets, revision of public subsidy schemes, linking livestock production to nationally determined contributions under the Paris Agreement). [FAO 2017a](#).
- P7 Ensure that natural resource management and climate change are adequately addressed in the sector's policies and strategies; ensure resources are available for adequate expertise during policy formulation.
- P7 Include or revise regulations to ensure consideration of natural resources in the zoning of livestock production. [LEAP 2016a](#), [WB 2017](#).

INTERVENTION: DEVELOP LIVESTOCK INFORMATION SYSTEMS

ACTIVITIES

- Develop identification and performance recording.
- Include livestock data in the agriculture census.
- Develop a database on livestock production at the central level.

GUIDANCE

- P7 Include data on environmental performance (e.g., GHG emission accounting, manure management practices, and farm-level nutrient balances) in livestock information systems.
- P7 Include training and resources for the collection of census data that can environmental performance assessment.

OBJECTIVE 1

OBJECTIVE 2

OBJECTIVE 3

OBJECTIVE 4

OBJECTIVE 5

OBJECTIVE 5: CLIMATE CHANGE RESILIENCE AND EMERGENCY RESPONSE

INTERVENTION: IMPROVE CAPACITIES AT CENTRAL AND LOCAL GOVERNMENT LEVELS

ACTIVITIES

- Assess and fill capacity gaps in relevant government ministries.

GUIDANCE

- P7 Support the establishment of a livestock and environment unit within the ministry of agriculture/livestock. Provide technical assistance and capacity building on environmental planning, monitoring, and extension in livestock production. [WB 2009](#).
- P7 Provide relevant ministries (e.g., agriculture, livestock, water, environment, rural development, finance, energy) with capacity building on livestock and environment issues.

INDICATORS

Environment (or natural resource) management unit created within the ministry (department) of livestock — Yes/No. This indicator measures the creation, staffing, and funding of a unit dedicated to environmental management. Its functions may include environmental monitoring, assessments, awareness raising, capacity development among public servants and private sector, administration of environmental funds, and development of policies and regulations.

- Quantification may be reported annually using project advancement reports.

INTERVENTION: ESTABLISH RESEARCH GRANTS AND EDUCATIONAL PROGRAMS

ACTIVITIES

- Provide financing options for research and education on livestock development issues.

GUIDANCE

- P7 Include calls for science and policy research proposals on, for example, crop-livestock integration, metrics of environmental sustainability, innovation and technology adoption on small-scale production units, and climate-smart agriculture.
- P7 In local universities and professional schools, develop educational programs on sustainable pastoral systems.

OBJECTIVE 1

OBJECTIVE 2

OBJECTIVE 3

OBJECTIVE 4

OBJECTIVE 5